BY DIANA VOS
PROJECT WILD COORDINATOR

WHEN FISH BECOME

Fish food

What does a fish catch for its supper?

WHEN YOU FIRST ponder this topic, you may think the answer is obvious—big fish gulp down smaller fish, which feast upon smaller fish that in turn eat even tinier fish and other small creatures. As you delve deeper into the subject, though, you'll learn it's more complicated than that. What different fish eat is influenced by a variety of factors.

Getting a mouthful

One factor that plays a role is the structure and position of a fish's mouth. The orientation of its mouth is an indication not only of what it eats but where it feeds. A fish with a mouth at the end of its snout (a terminal mouth) can feed throughout the water. Fish with an upper jaw protruding past their lower jaw (subterminal mouths) usually feed on prey they see below them. Fish with their mouths angled upward (superior position) feed on prey they see above them, such as aquatic insects on the surface of the water. Those with mouths opening downward (inferior position) are typically bottom feeders.

Fish that have large mouths filled with sharp teeth are predatory, which means they eat other living fish. Bass are an example of a large-mouthed fish that can engulf its prey. Many fish-eating fish have a hard-rimmed mouth with patches of small teeth on the roof of the mouth, or they have large teeth in the throat (pharyngeal teeth). Walleye are predatory fish with sharp, pointy teeth, and the squawfish has teeth in its throat. Some predatory fish, such as pike, have duckbill-like jaws that allow them to grasp their prey.

In contrast, fish with soft fleshy lips, such as suckers and carp, use their mouths to suck invertebrates, algae and organic debris off the bottom. Some of these bottom feeders, such as catfish, have the added benefit of having sensitive barbells on the sides of their mouth to help them sense food in murky water.

Most bony fish have small- to medium-sized, bony-lipped mouths on the end of their snout. Such mouths allow them to capture a variety of prey. These mouths are usually flexible and can be protruded rapidly to form a small, round opening while the mouth cavity is simultaneously expanded. The result is a sucking phenomenon similar to the action of an eyedropper. This sucking motion causes water

Sensitive barbells on the sides of their mouths help catfish find food.

Unlike other carp, grass carp eat underwater weeds and other vegetation.

to rush into the mouth of the fish at great speed, carrying with it plankton and other small organisms.

You are what you eat

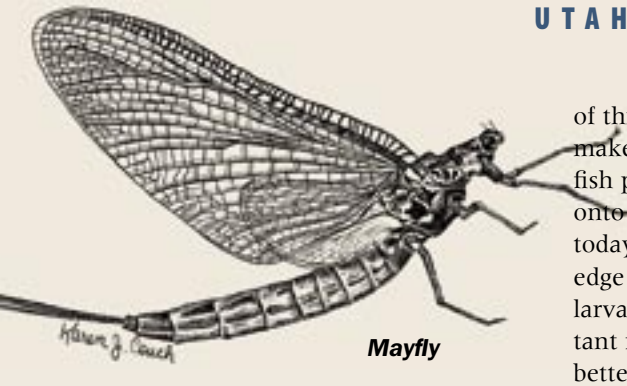
Fish can also be grouped according to the type of food they eat. Minnows are usually herbivores, mainly grazing on algae and aquatic plants. Such fish have long, convoluted intestines to digest their diet of vegetative matter. Fish that feed on a variety of plants, such as algae, and animals, such as insects, are classified as omnivores. Suckers and catfish fall into this category.

Fish that prey on other fish, as well as on other small vertebrates and large invertebrates (such as crayfish) are termed piscivorous. Some, such as large trout, can be voracious predators, even eating their own young. To avoid predators, schools of shiners and other small fish usually stay in the shallower parts of lakes. Piscivores, which include bass, squawfish and walleye, are often favorites of anglers.

In the deeper waters of lakes, beds of aquatic plants provide food and cover for various fish. While this cover provides fish protection from predators, it also offers predators places to hide as they wait for prey to ambush. For example, pumpkinseed hang out among plants in deeper water, where they pick snails off the leaves and stems, and bluegill concentrate in shallower water where insect larvae cling to plants. Lurking at the edges of these aquatic plant beds are largemouth bass waiting to capture any of these smaller fish that accidentally stray too far from the protective concealment of the aquatic plants.

Fish aren't the only piscivores found in many waters. Among the smallest piscivores are the same aquatic insects that are important food for the fish themselves. Stonefly larvae, dobson fly larvae and the larvae of some beetles often eat newly hatched trout. Garter snakes; various birds, including kingfishers, mergansers and herons; and mammals,

While most trout eat insects, large trout have been known to eat other fish.



Mayfly

such as mink, otter and humans, are among the animals that include fish as a major part of their diet.

Incredible insects

Most fish feed on invertebrates, including aquatic insects and their larvae, snails, leaches, worms and crustaceans. Fish that feed on bottom (benthic) invertebrates are mainly small species that search among rocks and vegetation for prey. In Western streams small minnows, such as speckled dace and juveniles of larger species, such as squawfish, are the predominant benthic invertebrate feeders. Sculpins, another invertebrate feeder, are small, flattened fish that live among rocks in faster water and ambush passing larvae. Small predatory fish often consume the eggs of other fish as well.

Many aquatic invertebrates tend to be more active at night, when it's harder for fish to see them. During this time, by accident or on purpose, many release their hold on the bottom and drift downstream to settle elsewhere, causing what is termed "drift." In cold-water streams, trout take advantage of this drift and feed heavily at dawn and dusk. Drift also occurs in warmwater streams and provides food to shiners, various sunfishes and small bass. Terrestrial insects that fall into the water from surrounding vegetation, as well as those that leave the vegetation to breed and lay eggs, are also an important food source for fish in streams.

Long ago, people realized that many fish eat aquatic insects. Aware of this relationship, people began to make lures resembling the insects fish prefer to eat. These "flies" placed onto hooks are the basis of what today is called "fly-fishing." Knowledge about the aquatic insects and larvae that fish prey upon is important for people who want to become better anglers.

Most aquatic insects live below the water's surface during their larval stage. The best place to find some of these aquatic insect larvae (also called nymphs) is on the underside of rocks in a stream.

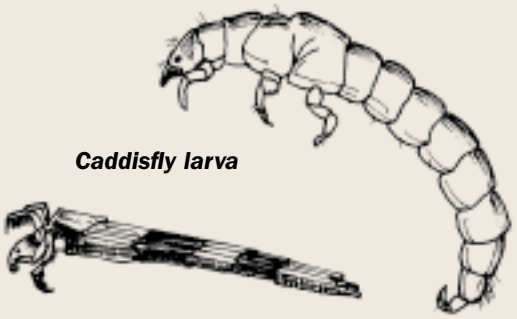
Two people can also collect a sample by having one person stand in a small stream and kick his or her feet among a cluster of small fist-sized rocks. The second person needs to be downstream with the edge of a fine-mesh screen stretched between two poles (kick seine) pressed along the bottom surface of the stream. Collected larvae can be viewed by dropping them off the screen into a white-bottomed container full of stream water. In a pond, all you have to do to collect aquatic insects and larvae is scoop up some mud and water with a strainer. Besides being important for fish, aquatic insects can be an important indicator of stream or lake health. Because they are so small, many insects are easily affected by even small amounts of pollution or disturbances in the environment. Stonefly, mayfly and caddisfly larvae are very sensitive to changes in stream conditions caused by pollution. Dragonfly and damselfly larvae prefer good stream quality, but can survive slightly lower water quality. Midge larvae and rat-tail maggots are among the most tolerant aquatic insects and have adapted to living in dirty or oxygen-depleted waters. The presence of many very tolerant insects, and fewer of the more sensitive insects, is an indication that conditions in the stream are probably not healthy for fish.

For more information about aquatic insects and their relationship to fish, see *wildlife.utah.gov/projectwild*. You'll also find a list of free educator resources, a reading list, related Web sites and a fun and engaging activity called "Hungry Trout Relay" that you can conduct with students.

A bluegill's small mouth is suited for eating small organisms like insects.

Getting WILD!

Utah's WILD Notebook is produced by Utah's Project WILD program. WILD workshops, offered by the Utah Division of Wildlife Resources, provide teachers and other educators with opportunities for professional development and a wealth of wildlife education activities and materials for helping students learn about wildlife and its conservation. For a current listing of Project WILD educator workshops, visit the Project WILD website at http://www.wildlife.utah.gov/projectwild or e-mail dianavos@utah.gov.



Caddisfly larva

Aquatic insect fish favorites

Caddisflies: Caddisflie belong to the order Trichoptera, which means "hairy-winged" and refers to the wings of the moth-like adult phase. As soon as they hatch from their eggs, most caddisflys begin building a home around them selves. Different caddisfly species build homes from different materials. Some use sticks, whereas others use sand, small pebbles, bark or small pieces of plants. Some cases are round in shape and others are shaped like a tiny box or like little horns. Caddisfly larvae eat algae and other plant or animal material. They feed by sticking their heads, legs and antennae out of their home or case to catch food that is floating by. Some even weave miniature nets they use to capture food to eat.

Mayflies: Mayflies belong to the order Ephemeroptera, which refers to their short, ephemeral life as an adult. Adult mayflies have no mouths, so cannot feed, and live only long enough to mate and lay their eggs. The females lay their eggs by dipping their abdomens into the water. Afterwards they die and fall upon the water's surface to be gulped up by hungry fish. Mayfly nymphs hide in cracks or among the bumps on rocks. They can move very quickly over the surface of a rock. Those that live in fast-moving water have flat bodies. Some even have little suction cups on their feet to help them hold onto rocks while the forage for food. A distinctive feature of mayfly larvae is the three thin trailing "tails" at the end of their body. Mayfly larvae feed on detritus, small organisms and algae until fully developed. They then emerge from the water to complete their life cycle.

Stoneflies: Stoneflies are usually larger and more robust than mayflies. As adults, some can grow as long as two inches in length. Stoneflies belong to the order Plecoptera. As their name implies, as nymphs, they are creatures of stony or gravel-bottomed rivers where they scuttle about over rocks feeding on detritus in their early stages and then becoming herbivores or carnivores depending on the species. Stonefly nymphs differ from the nymphs of mayflies in having two tails rather than three. When ready to leave their underwater home, they climb out onto a rock to dry. The skin along the back of the thorax splits and the adult emerges to mate, lay eggs and then die.

Dragonflies: Dragonflies are large, predatory insects belonging to the order Odonata. As adults their bright, iridescent colors and shimmering wings make them a sight to behold. As both adults and nymphs below the water's surface they are voracious predators. Dragonflies spend about 90–95 percent of their lives in their nymph stage where they feeding on other aquatic insects, crustaceans, worms, small fish and tadpoles. To help it capture prey, the nymph has a unique adaptation. Its lower lip (called a labium) is long and hinged. The labium, folded under the head most of the time, can be suddenly and rapidly extended like an arm to grab unsuspecting prey.

Midges: A variety of non-biting midges within a genus Chironomous make up a large portion of the diet of trout in still water environments. The larva of a midge is a wormlike creature that burrows into the bottom mud. They vary in color from pale olive and brown. One species, known as the bloodworm is a vivid blood-red in color because its body contains hemoglobin. This hemoglobin enables the species to thrive in the oxygen-poor mud of lakebeds. When the larvae pupate, the pupae remain in their mud burrows until fully developed. They then rise to the surface to transform into adults. It is at this point in their life cycle that fish gobble them up in great quantities.

Caddisfly

WILD About Reading

Books for learning more

- *Strange Beginnings* by Karen Needham and Launi Lucas, Croccodile Books, 2002.
- *Freshwater Fish and Fishing* by Jim Arnosky, Four Winds, 1991.
- *Lightning's Tale: The Story of a Wild Trout* by Hugh Campbell, Frank Amato Publications, 2000.
- *Fish: An Enthusiast's Guide* by Peter B. Moyle, University of Califor-

nia Press, 1993.

• *A Guide to Common Freshwater Invertebrates of North America* by J. Reese Voshell Jr., McDonald and Woodward Publishing Company, 2002.

Related Web sites:

• Dichotomous Key for Aquatic Insects: http://virtual.clemson.edu/groups/SCLife/student%20handout%20-%20aquatic%20insects.pdf

• Fly Fishing—Imitating Aquatic Insects: www.flyfishingdvd.com/AquaticInsects.html

• Aquatic Invertebrates: http://chamisa.freeshell.org/inverts.htm

• EEK Aquatic Critter Key Game: http://www.dnr.state.wi.us/org/caer/ce/eek/critter/watercritter/aquatict.htm

• Fish of Utah—Utah Conservation Data Center: http://dwrcdc.nr.utah.gov/rsgis2/Search/SearchSelection.asp?Group=OSTEICHTHYES&Species=VERT

• Utah Fish Flash Cards Online: http://www.wildlife.utah.gov/fishing/fishinginfo.html Select "Fish of Utah"

• Know Your Fish: http://www.angelfire.com/ia3/fishing/whatfisheatwhat.htm

• Interactive Fish ID Flashcards: http://www.cnr.colostate.edu/~brett/fw300/flashcrd/

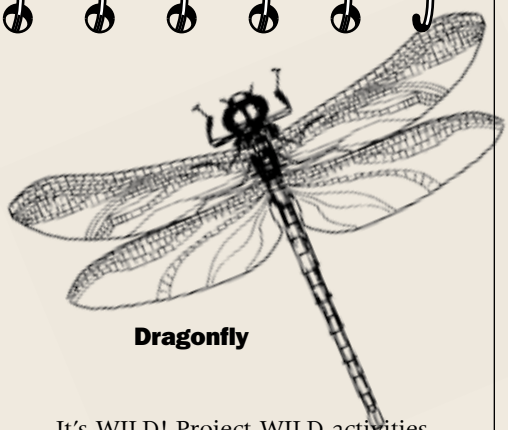
• Ecology of a Stream: A Tale of Balance http://www.combat-fishing.com/streamecology.html

• Kidfish: http://www.kidfish.bc.ca/frames.html (select Aquatic Fish Food from menu on top of page)

• Benthic Macroinvertebrates Overview: http://www.in.gov/dnr/soilcons/riverwatch/pdf/manual/Chap5a.pdf

• Aquatic Food Chain: http://people.westminstercollege.edu/faculty/tharrison/CityCreek/Aquatic_Invertebrates/

• Why are Macroinvertebrates Important to the Aquatic Ecosystem? http://www.dcmc.org.au/fact_sheets/macroinvertebrates.doc



Dragonfly

It's WILD! Project WILD activities for teachers and students that correlate to this topic include:

• Fishy Who's Who
• Are You Me?
• Water Canaries
• What's In the Water?
• Blue Ribbon Niche
• Something's Fishy Here

WILD Educator Resources Contact Project WILD for information (801) 538-4719.

• Utah Fish Coloring Pages
• Utah Fish Posters
• Videos for checkout:
  Bill Nye The Science Guy: Fish
  Fascinating Fishes
  Fish: Eyewitness Video
  Bug City: Aquatic Insects

Energy flow in an aquatic food chain

WITHIN ANY FOOD CHAIN there is a flow of energy. Starting with the sun, radiant energy is transferred to green plants. In the aquatic realm, it is phytoplankton, algae and aquatic plants that take in the sun's energy and convert it to sugars or carbohydrates (chemical energy). These plants are the producers in the food chain. They also need nutrients, made available by decomposers, and minerals to grow.

The primary consumers, or herbivores, gain their energy by feeding upon the plant life in the aquatic ecosystem. Secondary level consumers, or carnivores, then feed upon the primary consumers. Within many food chains there may be at least one or two more levels of consumers that feed upon lower level consumers. The levels of consumers are called trophic levels.

Most of the chemical energy used at each level of a food chain goes towards sustaining an animal's activity and towards its growth. Some (about 10 percent) however is lost during the transfer between trophic levels. This 10% "rule" states that only 10 percent of the useful energy at one level will be passed on to the next higher level. This creates a pyramid with a broad base representing the total amount of biomass at various levels, peaking with a small layer at the top level consisting of the top predators.

This explains why there are fewer predators as compared to smaller fish and other small organisms at lower levels of the pyramid.

Within this scheme, to sustain a 10-pound walleye, a top predator, 100 pounds of perch would be needed each year. One hundred pounds of perch would need one-half a ton of minnows. Those minnows would require five tons of worms and insects for their survival. And the worms and insects would need 50 tons of plants to live upon! Think about this and you can see how valuable one large game fish really is.